

MASTER-VAC

Vacuum Suspended Single and
Tandem Diaphragm Units

Power Brake Service Manual 9-208

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BENDIX AUTOMOTIVE SERVICE
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VACUUM SUSPENDED DIAPHRAGM TYPE MASTER-VAC (Single Diaphragm Type with Single or Split System Master Cylinder)

DESCRIPTION

Starting with 1962 production, Bendix Master-Vacs are of the Vacuum suspended diaphragm type. Some units are of the single diaphragm type while others are of the tandem diaphragm type. Both single piston and double piston or split system type master cylinders are used. The vacuum suspended diaphragm type Master-Vac utilizes engine manifold vacuum and atmospheric pressure for its power. It consists of three basic elements combined into a single power unit (See Fig. 3). The three basic elements of the single diaphragm units are:

1. A vacuum power section which includes a front and a rear shell, a power diaphragm, a return spring and a push-rod.
2. A control valve built integral with the power diaphragm and connected through a valve rod to the brake pedal controls the degree of brake application or release in accordance with the pressure applied to the brake pedal.
3. A hydraulic master cylinder attached to the vacuum power section which contains all of the elements of the conventional brake master cylinder except for the push rod, supplies fluid under pressure to the wheel brakes in proportion to the pressure applied to the brake pedal by the driver.

The control valve consists of a single poppet with an atmospheric port and a vacuum port. The vacuum port seat is a part of the diaphragm plate while the atmospheric seat is a part of the valve plunger which moves with the valve rod within the power diaphragm assembly.

The master cylinder may be of the single piston type or the tandem (split system) type. In the split system type, the primary section of the master cylinder actuates the front brakes while the secondary section of the master cylinder actuates the rear brakes.

Principle of Operation of the Single Diaphragm Type Master Vac

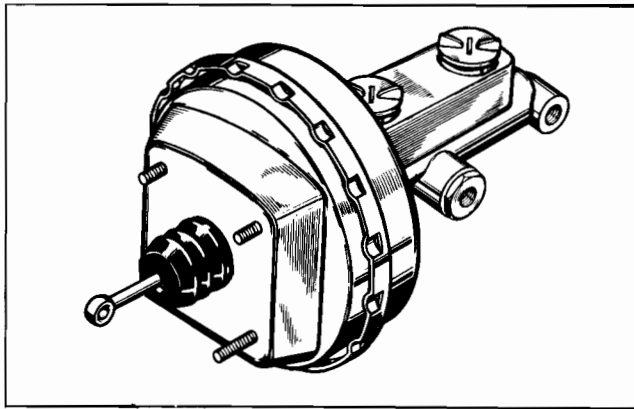


Fig. 1 External View

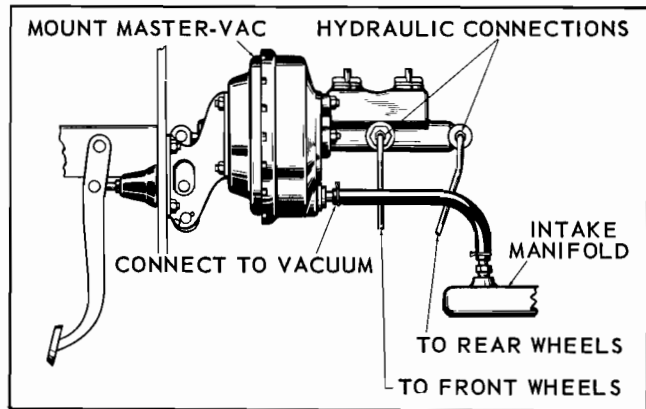


Fig. 2 Typical Installation Diagram

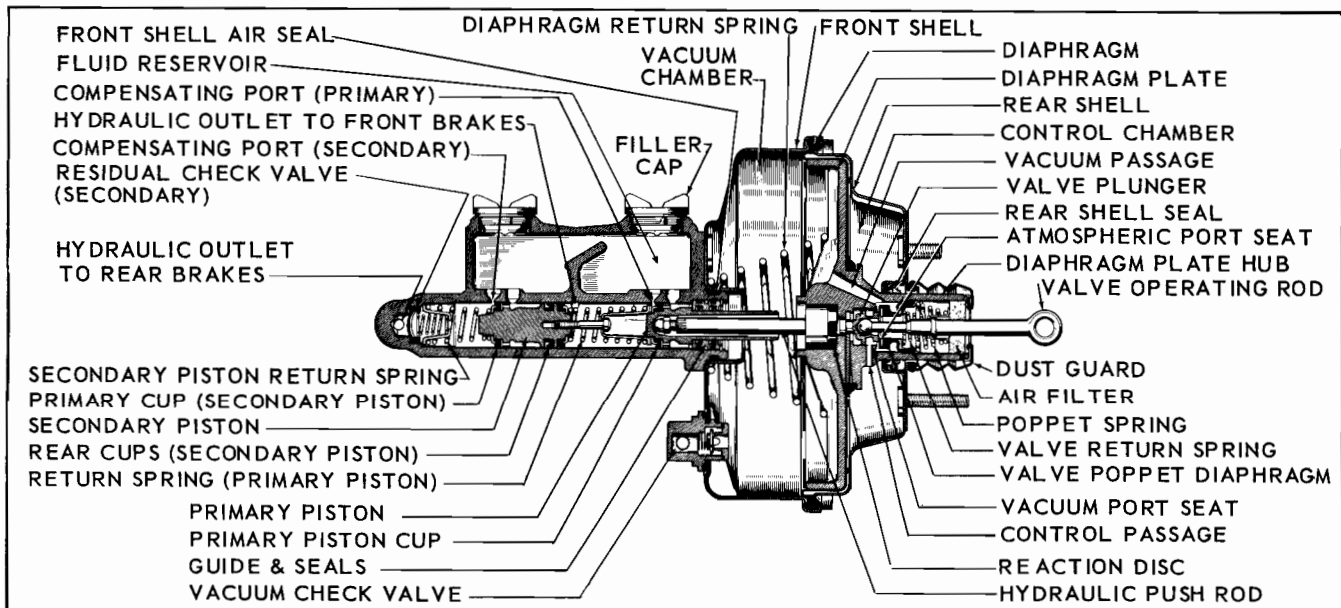


Fig. 3 Cutaway View with Basic Parts Named

PRINCIPLES OF OPERATIONS

RELEASED POSITION

With the engine running and the brakes released, vacuum from the engine intake manifold is admitted to the front chamber of the Master-Vac through the vacuum tubing hose and check valve. With the valve in the released position, the atmospheric port is CLOSED and the vacuum port of the valve is OPEN to admit vacuum through the passage in the diaphragm

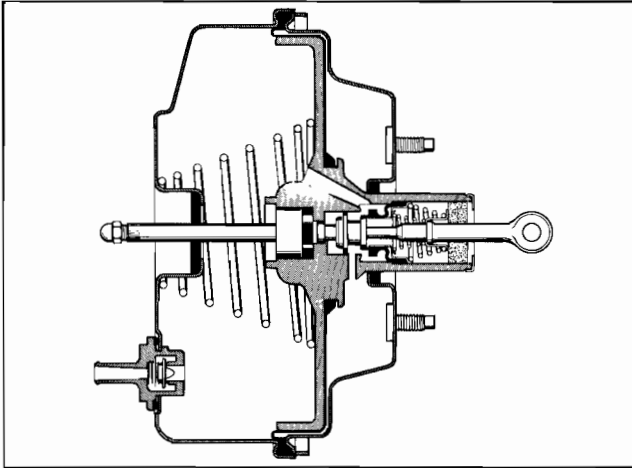


Fig. 4 Released Position

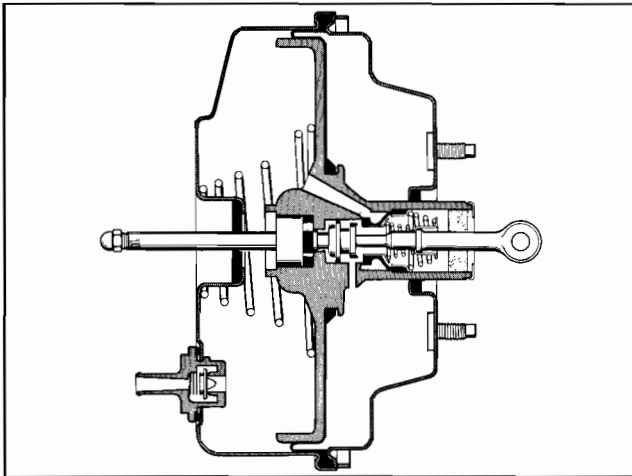


Fig. 5 Applied Position

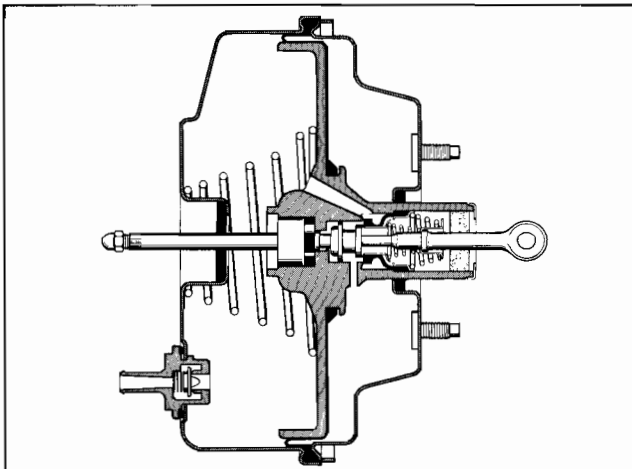


Fig. 6 "Lap" or Holding Position

plate and valve to the rear chamber of the Master-Vac. With vacuum present in both the front and rear chambers, the diaphragm is balanced or suspended in vacuum. The diaphragm return spring then holds the diaphragm in the released position.

APPLIED POSITION

Upon application of the brakes, the valve rod and plunger move to the **left** in the power diaphragm to **CLOSE** the vacuum port and **OPEN** the atmospheric port to admit air through the air cleaner and valve to the rear diaphragm chamber. With vacuum present in the front chamber and atmospheric pressure in the rear chamber, a force is developed to move the power diaphragm, hydraulic push-rod and hydraulic piston or pistons to close the compensating port or ports and force fluid under pressure through the residual check valve or valves and lines into the front and rear wheel cylinders to actuate the brakes. As pressure is developed within the master cylinder a counter force acting through the hydraulic push-rod and reaction disc against the vacuum power diaphragm and valve plunger sets up a reaction force opposing the force applied to the valve rod and plunger. This reaction force tends to **close** the atmospheric port and **reopen** the vacuum port. Since this force is in opposition to the force applied to the brake pedal by the driver it gives the driver a "feel" of the amount of brake applied. The proportion of reactive force applied to the valve plunger thru the reaction disc is designed into the Master-Vac to assure maximum power consistent with maintaining pedal feel. The reaction force is in direct proportion to the hydraulic pressure developed within the brake system.

LAP OR HOLDING POSITION

During brake application, the reaction against the valve plunger is constantly tending to **close** the atmospheric port and **reopen** the vacuum port of the valve. With both ports closed, the Master-Vac is said to be in the "lap" or holding position and any degree of brake application attained will be held until either the atmospheric port is reopened by an increase in pedal pressure to further increase the brake application or by a decrease in pedal pressure to partially reopen the vacuum port to decrease the brake application. When the pressure applied to the brake pedal is held constant, the valve returns to its "lap" or holding position. However, when full power application is attained, the atmospheric port remains open until the pressure on the pedal is reduced.

NO POWER CONDITION

It should be noted in the case of engine failure and consequent loss of engine vacuum, at least one full power brake application or several partial brake applications may be made from the vacuum in the Master-Vac. In the case of no vacuum in the power system, the brakes can be applied in the conventional manner by applying more physical effort to the brake pedal.

BENCH OVERHAUL

Always use a Bendix Master-Vac Repair Kit when overhauling a Master-Vac. For identification of Master-Vac, refer to code stamp on flat of rear shell. For correct Repair Kit to use and for complete list of service parts, refer to Bendix Power Brake Parts Catalog.

Due to the design of the Master-Vac, a special Assembly Fixture (part number 73800) is recommended for disassembly and reassembly of the Master-Vac.

The following service procedure is based upon the use of the assembly fixture and applies to the complete Master-Vac (vacuum power section plus master cylinder and pedal linkage if used).

DISASSEMBLY

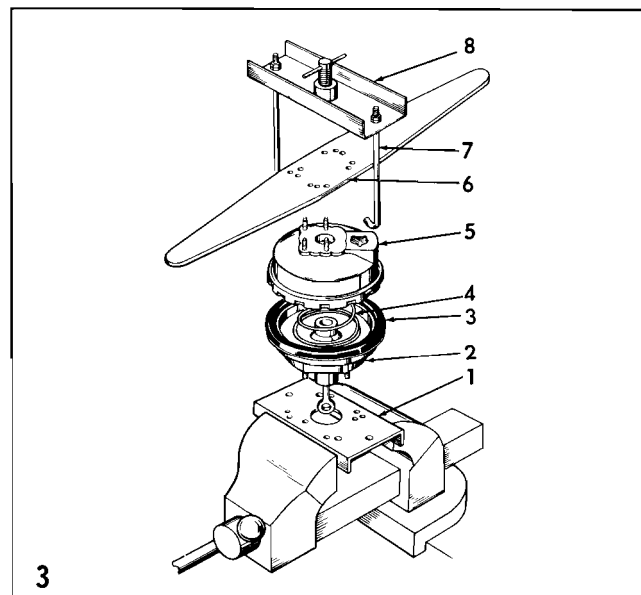
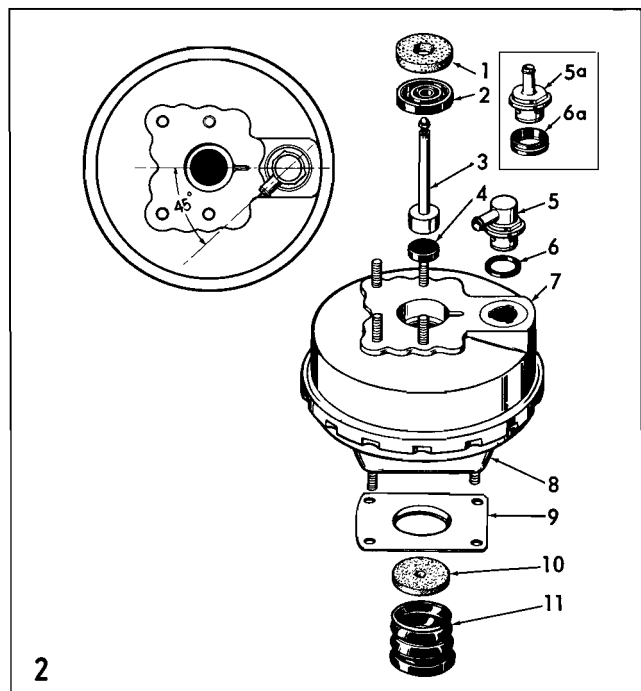
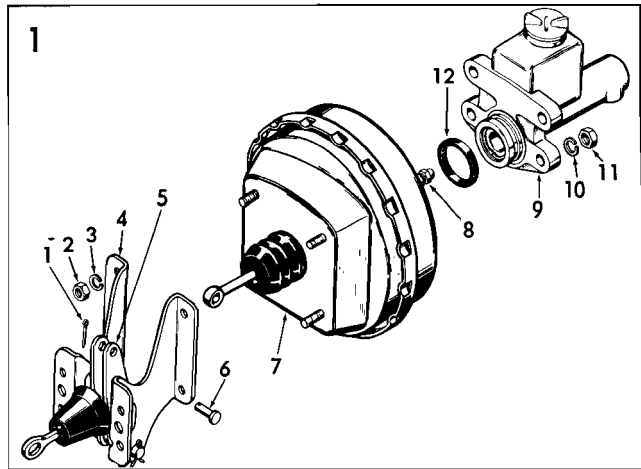
1. Scribe across front and rear shells and across master cylinder and mounting bracket if unit includes brackets. Remove master cylinder attaching nuts (11) and lockwashers (10) and set master cylinder (9) aside. Note: DO NOT disturb adjustment screw (8) at end of hydraulic push-rod. If Master-Vac includes power lever assembly (5) and/or mounting brackets (4), remove cotter pin (1) and clevis pin (6) from end of valve rod and power lever assembly. Remove mounting bracket attaching nuts (2) and lockwashers (3) and remove mounting brackets from power section (7).

2. Remove hydraulic push-rod (3) from front shell (7) and then remove air filter (1) (if used) and push-rod seal (2) (if used). Remove rubber dust guard (11) and retainer plate (9) from rear shell (8). To remove vacuum check valve (5) from units with elbow type check valve, press and twist check valve counter clockwise in front shell (7) to released position and then remove check valve with gasket (6). DO NOT remove vacuum check valve from unit with straight type check valve at this time.

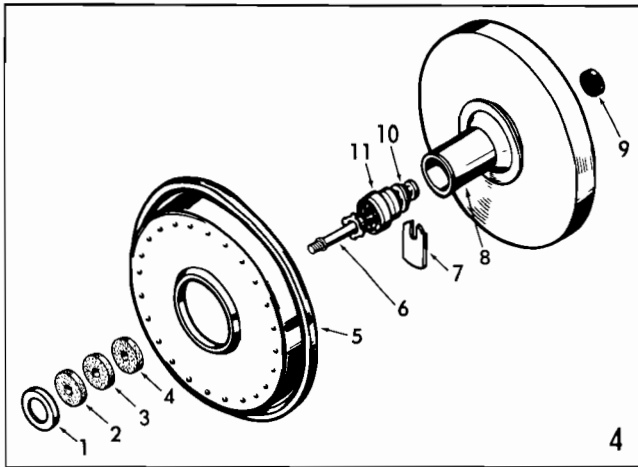
3. To separate front and rear shells, clamp fixture base (1) in bench vise. Insert studs of rear shell (2) in holes of base. Place bar wrench (6) over stud of front shell (5) and align top clamp (8) with base and attach hook bolts (7) to base. Tighten center bolt just enough to free lock at outer rim of rear shell. Turn bar wrench **counter-clockwise** just enough to align cut-outs on rear shell flange with lances in front shell. Loosen center bolt. Shells should begin to separate as load on bolts is removed. If shells **do not** separate, recheck alignment of lances with cut-outs and tap front shell with soft hammer to break bond between front and rear shells and diaphragm.

WARNING: Press down firmly while removing hook bolts to prevent diaphragm return spring from causing shells to fly apart.

Remove hook bolts, top clamp bar, bar wrench, front shell (5) and return spring (4) from diaphragm and shell assembly.



DISASSEMBLY



4. Pry off filter retainer (1) from end of hub of diaphragm (8) being careful not to damage plastic housing and then remove air filter (2) and air silencers (3) and (4) if used. Remove diaphragm (5) from diaphragm plate (8) then remove valve retainer lock key (7) and valve and rod assembly (6). Press out reaction disc (9) from diaphragm plate.

5. Support rear shell (1) on wooden blocks (2) and drive out seal (3) from rear shell. Note. **DO NOT** remove seal unless new seal is available.

6. Operation 6 applies to units with single piston type master-cylinder.

Remove snap ring (1), piston assembly (2), primary cup (4), spring and retainer (5) and check valve (6) from master cylinder bore. If secondary cup (3) is defective, remove cup from piston with ice pick or thin blade screw driver. Remove filler cap (8) from master cylinder housing (7).

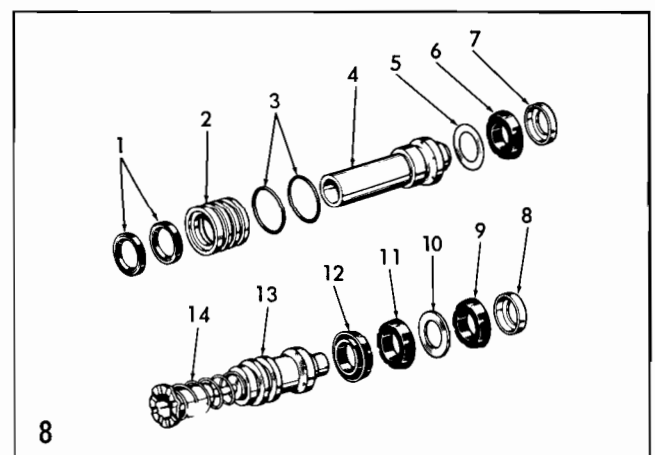
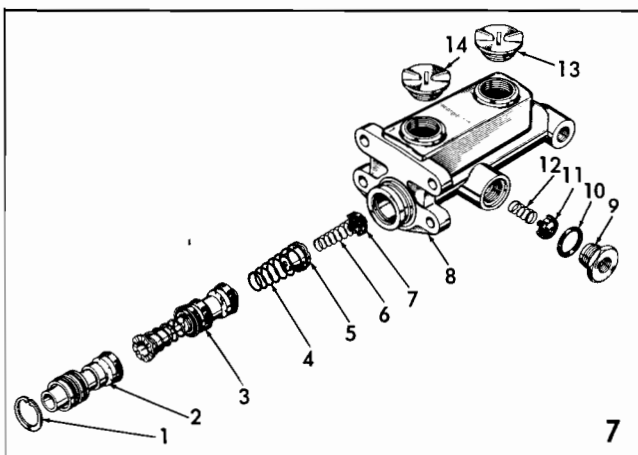
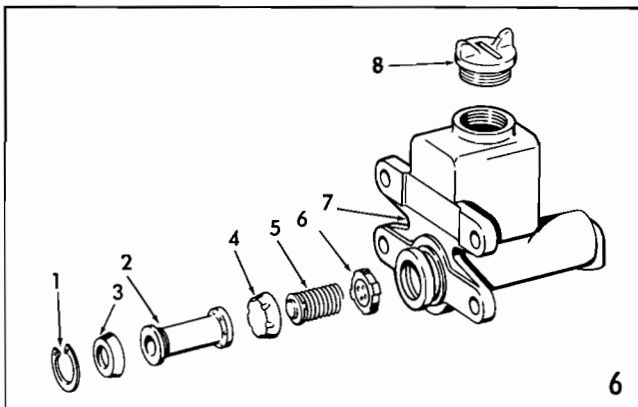
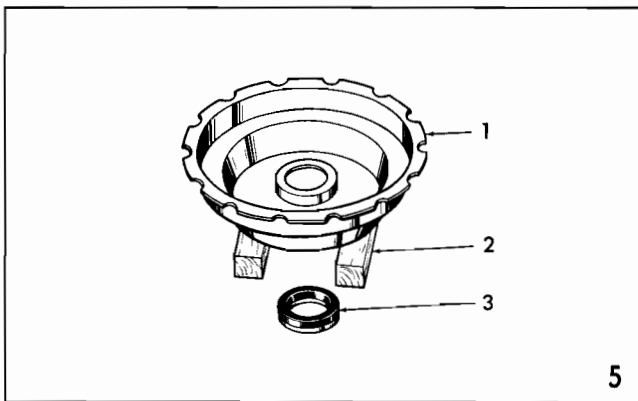
NOTE: Operations 7 and 8 apply only to units with double piston (Split System Type) Master Cylinder.

7. Remove filler caps (13) and (14) from master cylinder assembly. Then remove hydraulic fitting (9), spring (12) and residual check valve (11) from side outlet of master cylinder. Remove gasket (10) from fitting.

Remove snap ring (1), primary piston and stop assembly (2), secondary piston and stop assembly (3), secondary spring (4), spring stop (5), check valve spring (6) and check valve (7) from master cylinder housing (8).

8. Remove plastic piston stop (2) from primary piston (4) and then remove "O" ring seals (3) from outer grooves of piston stop and seals (1) from inside diameter of piston stop. Remove retainer (7), piston cup (6), and cup protector washer (5) from primary piston (4).

Remove retainer (8), piston cup (9), and protector washer (10) from forward end of secondary piston assembly. Using thin blade screw driver or ice pick, remove cups (11) and (12) from secondary piston. Compress spring (14) while removing cup (12). **DO NOT** disturb adjustment screw as screw is adjusted to a very close tolerance.



CLEANING

After disassembly, immersion of all metal parts in Bendix Metalclene or Speedclene is recommended. Plastic parts and rubber parts should be cleaned **only** in alcohol. Care should be taken to prevent chipping of or damage to plastic parts. All rubber parts should be replaced. After parts have been thoroughly cleaned, those parts which come in contact with brake fluid should be rewashed in clean alcohol before assembly. Use air hose to blow out dirt and cleaning solvent from recesses and internal passages. When overhauling a Master-Vac, use all parts furnished in the Master-Vac repair Kit. **DISCARD ALL OLD RUBBER PARTS.**

INSPECTION

Inspect all other parts for damage or excessive wear. Replace any damaged, worn or chipped parts. Inspect master cylinder bore for scoring, rust, pitting or etching. Any of these will require replacement of master cylinder.

ASSEMBLY

Note: Operation 1 applies to Master-Vacs with single piston type master cylinder. Operations 2 and 3 apply to Master-Vacs with double piston (Split System Type) master cylinder.

1. Before assembly of Master Cylinder, thoroughly clean all internal parts in alcohol and place in a clean pan or on a clean paper. Coat bore of master cylinder (7) with brake fluid. If secondary cup (3) was removed from piston (2) replace with new cup. Dip cup in brake fluid and assemble cup on piston from end shown. Dip master cylinder parts (2), (4), (5) and (6) in brake fluid and assemble in bore of master cylinder in order shown. Hold parts in place and assemble snap ring (1) making certain snap ring is seated in ring groove.

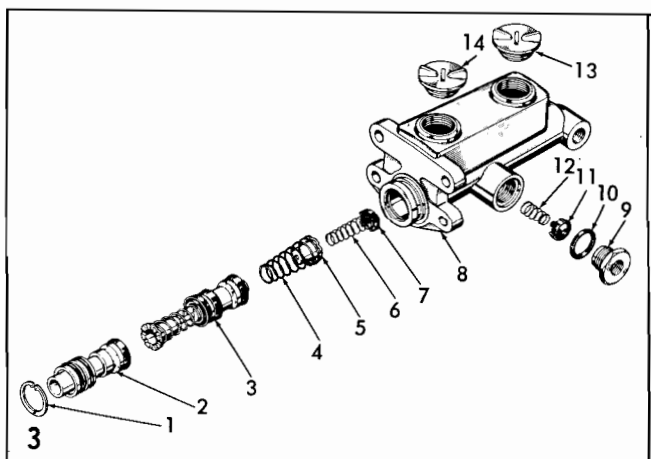
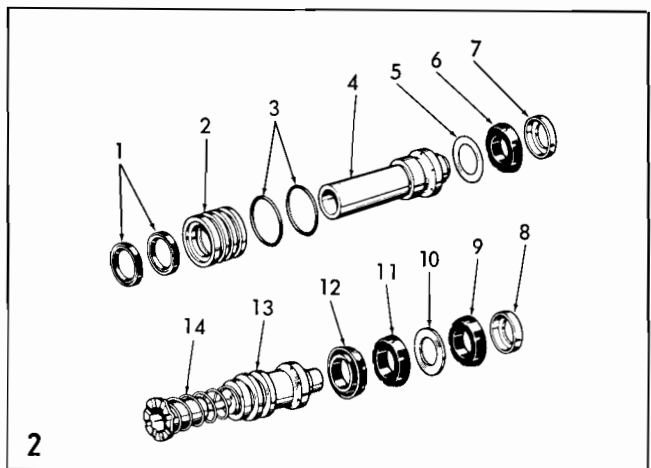
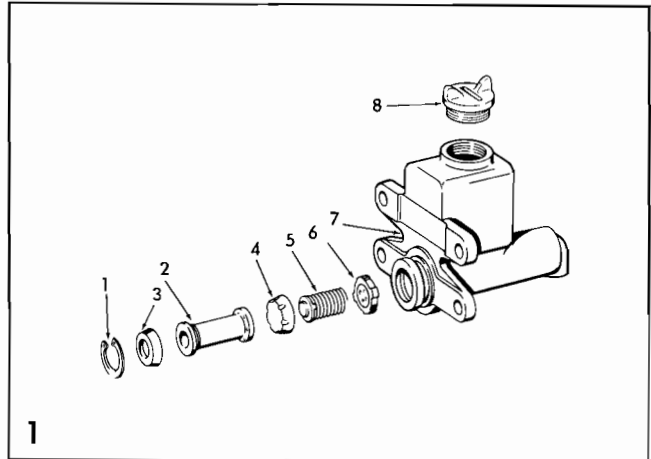
2. Dip all cups, seals, pistons, springs, check valves, and retainers in alcohol and place in clean pan or on a clean paper.

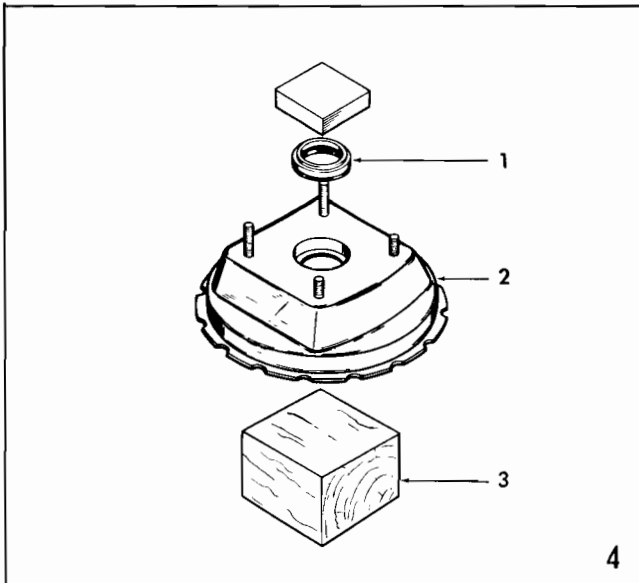
Assemble "O" ring seals (3) in grooves at outside diameter of piston stop (2) and assemble seals (1) in grooves at inside diameter of piston stop. If cup type seals are used assemble with lip of cups away from end of piston stop which has counter bore. Assemble cup protector (5), piston cup (6) and cup retainer (7). Lip of cup toward front end of piston.

Dip piston cups (12) and (11) in brake fluid and assemble cups over piston (13) from end shown with cups back to back. To seat cup (12) compress spring (14) with cup retainer and center retainer on cup. Assemble protector washer (10), cup (9), and retainer (8) on end of piston (13).

NOTE: Use tool (73805) to assemble stop over piston.

3. Coat inside bore of master cylinder with brake fluid. Dip secondary piston and cups in brake fluid. Stack secondary piston and stop assembly (3), secondary piston spring (4), (small diameter end of spring next to piston) and piston stop (5). Insert larger diameter end of check valve spring (6) in recessed end of check valve (7) and place these parts on piston stop and carefully guide this group of parts into bore of master cylinder (8). Inspect through side outlet in master cylinder housing to make certain lip of cups DO NOT hang up on edge of hole or turn back which would result in faulty operation. A piece of 3/16" diameter rod with end rounded off may be helpful in guiding cups past side hole in master cylinder. Dip primary piston stop in brake fluid and assemble over end of primary piston with "V" groove at end of piston stop toward outer (rear) end of piston. Dip primary piston cup in brake fluid and guide primary piston and stop into position in cylinder bore and assemble snap ring (1) in ring groove.

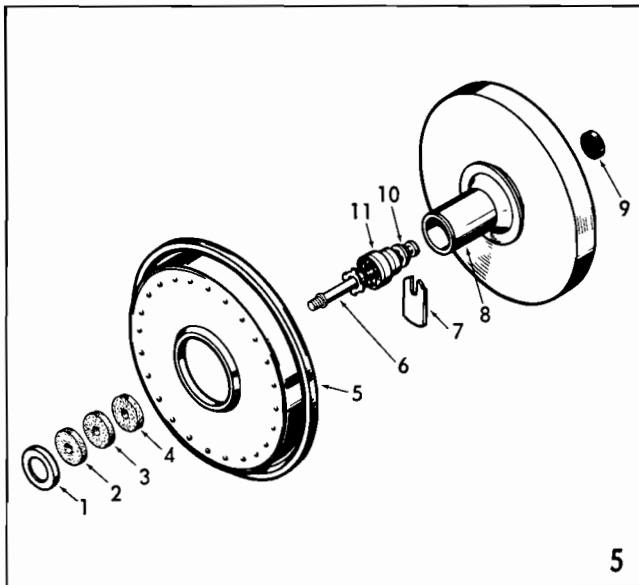




Dip residual check valve (11) in brake fluid. Insert spring (12) in recessed end of check valve and assemble spring and check valve in side outlet of master cylinder. Place new gasket (10) on outlet fitting. Tighten fitting to a torque of 50 to 70 foot pounds. Assemble filler caps (13) and (14) in master cylinder. On units with one vented cap, the vented cap is installed in the outlet at forward end of master cylinder.

4. If seal was removed from rear shell, press new seal (1) in rear shell (2) with seal assembly tool (#73799) until outer flange of tool bears against rear shell surface adjacent to seal. Plastic side of seal to be next to seal assembly tool. Use block of wood (3) to back up shell when assembling seal.

5. Apply Bendix type "O" lubricant to outer diameter of diaphragm plate hub (8) and to bearing surfaces of valve plunger (10) and to outer edge of rubber valve poppet (11).

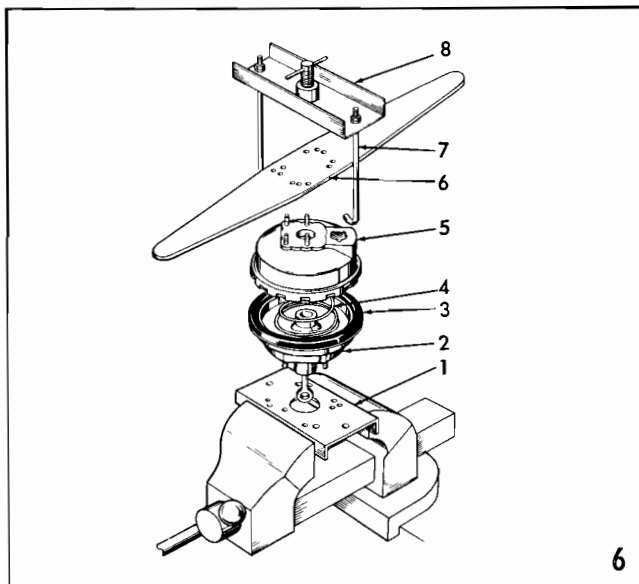


Insert valve and rod assembly (6) in hub of diaphragm plate. Press valve plunger and poppet into position in diaphragm hub and align slot in diaphragm plate with groove in valve plunger. Insert plunger lock (7) and assemble diaphragm (5) in groove of diaphragm plate. Assemble air filter (2) over valve rod and guide into place in valve housing. Press filter retainer (1) on end of valve housing using care not to chip or damage plastic housing.

Note: On Master-Vac with code stamp P-3, install air strainers (3) and (4) over end of valve rod before assembly of filter (2).

6. Place rear shell (2) on assembly fixture base (1). Apply DC4 Silicon lubricant liberally to the top outer flange of the rear shell. Apply Bendix type "O" lubricant to the bearing seal in the rear shell and guide plastic valve housing through seal in rear shell. Assemble diaphragm return spring (4), on diaphragm plate, and front shell (5). Align front shell so that when shells are locked in position, scribe marks on front and rear shells will be in alignment. Place bar wrench (6) over studs of front shell, with top clamp bar (8) positioned to line up with fixture hole. Press down to compress spring and attach hook bolts (7) to base. Align retaining lances and cut-outs in front and rear shells. Partially tighten center bolt. Make certain front shell is centered on rear shell and continue to tighten center bolt until dimension from outer rim of front shell to flange on rear shell is approx. 1/32" greater than the depth of the lance in the front shell. Check at two opposite points. Turn front shell **clockwise** with bar wrench (6) (approx. 11°) to bring front and rear shells into the locked position.

NOTE: If center bolt is drawn down too tight, rim of diaphragm may be damaged resulting in a vacuum leak. When shells are locked in place, remove hook bolts and assembly fixture.



ASSEMBLY

7. Apply Bendix type "O" lubricant sparingly to hydraulic push-rod (3) keeping lubricant away from adjusting screw end of rod. Apply type "O" lubricant liberally to piston end of push-rod and to entire surface of reaction disc (4) and assemble disc on end of push-rod. Guide reaction disc and push-rod into center bore of diaphragm plate. Assemble seal (2) (if used) over end of push-rod as shown. Press seal into front shell until bottomed in recess of shell. Assemble filter (1) (if used) on push-rod and position against seal. Assemble retainer plate (9) over studs in rear shell.

Assemble felt washer (10) (if used) in rubber guard (11) next to air intake holes and assemble guard over valve rod and attach guard to flange of retainer (9). If straight type vacuum check valve was removed, wet grommet (6a) in alcohol and assemble grommet in front shell. Make certain grommet is seated in front shell. Then wet shoulder of check valve (5a) in alcohol and assemble check valve in grommet. Flange of check valve should bear against grommet when assembled. Master Vacs, with elbow type check valve, use "O" Ring type gasket with check valve and are assembled by pressing and twisting check valve **clockwise** to locked position. Check valve for unit with code stamp CA3 is assembled with outlet of check valve positioned 45° up to left from horizontal as shown. Check valve for unit with code stamp S-1 is assembled with outlet of check valve positioned horizontally with outlet to left when viewed from master cylinder end.

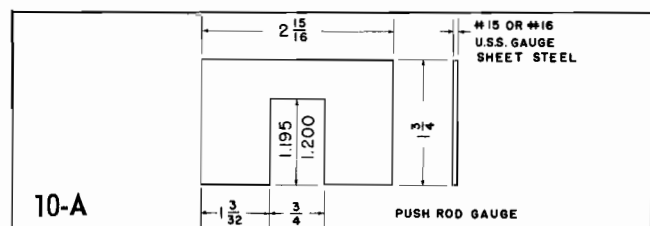
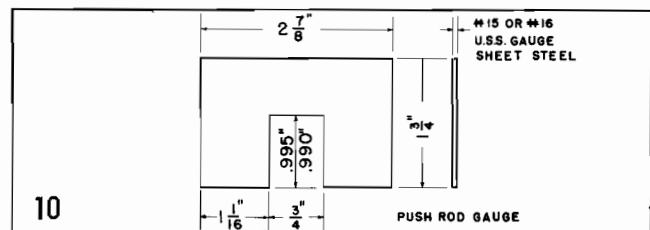
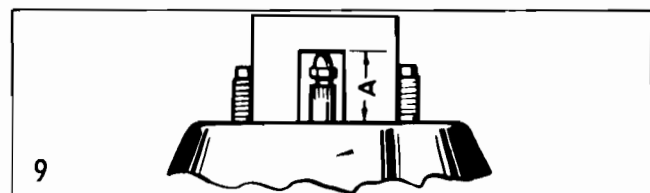
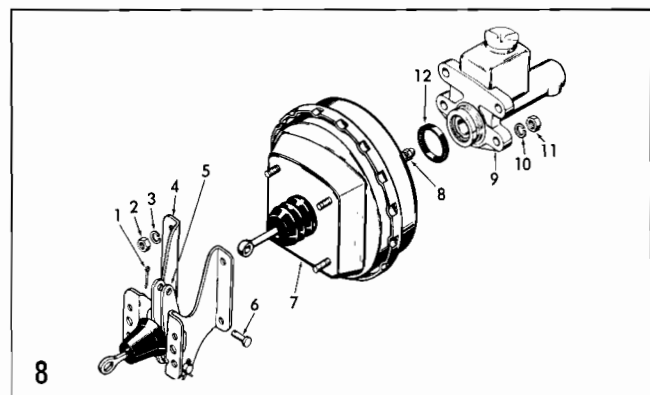
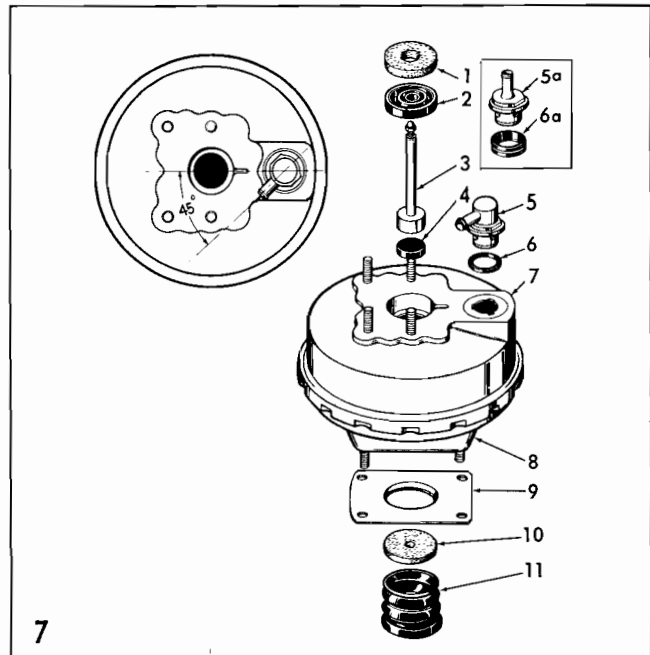
Master-Vacs identified by code stamp CA-3 and R-1 do not use push-rod seal (2) or filter (1). Filter (1) used only with units identified by code stamp C-2 and H.

8. **NOTE:** Before attaching Master Cylinder to power section, check distance "A" from end of hydraulic push-rod (8) to the hydraulic cylinder mounting surface at front end of the power section. The dimension "A," See Fig. 9, should be 1.195" to 1.200" for all units except R-1. Dimension "A" from R-1 unit is .990 to .995. If push-rod length is not correct, follow push-rod adjustment procedure below. On units identified by code stamp CA-3 or R-1, assemble rubber seal (12) in groove on hub of master cylinder (9). When push-rod length is correct, attach master cylinder to power section with attaching lock-washers (10) and nuts (11). Securely tighten nuts. Make certain master cylinder is aligned to scribe marks. If Master-Vac includes brackets, power levers, pedal link etc., assemble brackets (4) with nuts (2) and lockwashers (3) then attach power levers (5) with clevis pin (6) and cotter pin (1).

PUSH-ROD ADJUSTMENT

To adjust, hold push-rod and turn adjusting screw either "IN" or "OUT" of push-rod to obtain specified dimension using either a micrometer gauge or a height gauge. Fig. 10 and 10a give details for making either or both height gauges.

ASSEMBLY IS NOW COMPLETED



BENDIX MASTER-VAC POWER BRAKE UNIT

(Vacuum Suspended Diaphragm Tandem Type Units)

DESCRIPTION

The Master-Vacs used on some 1962 model vehicles use a tandem diaphragm type of Master-Vac. The tandem diaphragm type incorporates a center plate, a center plate hub, two diaphragms, two diaphragm plates, a valve housing, a reaction disc housing, as well as modifications in the push-rod seal, valve plunger, valve rod, air cleaner, vacuum passages and method of assembly of valve plunger, valve rod, poppet and springs.

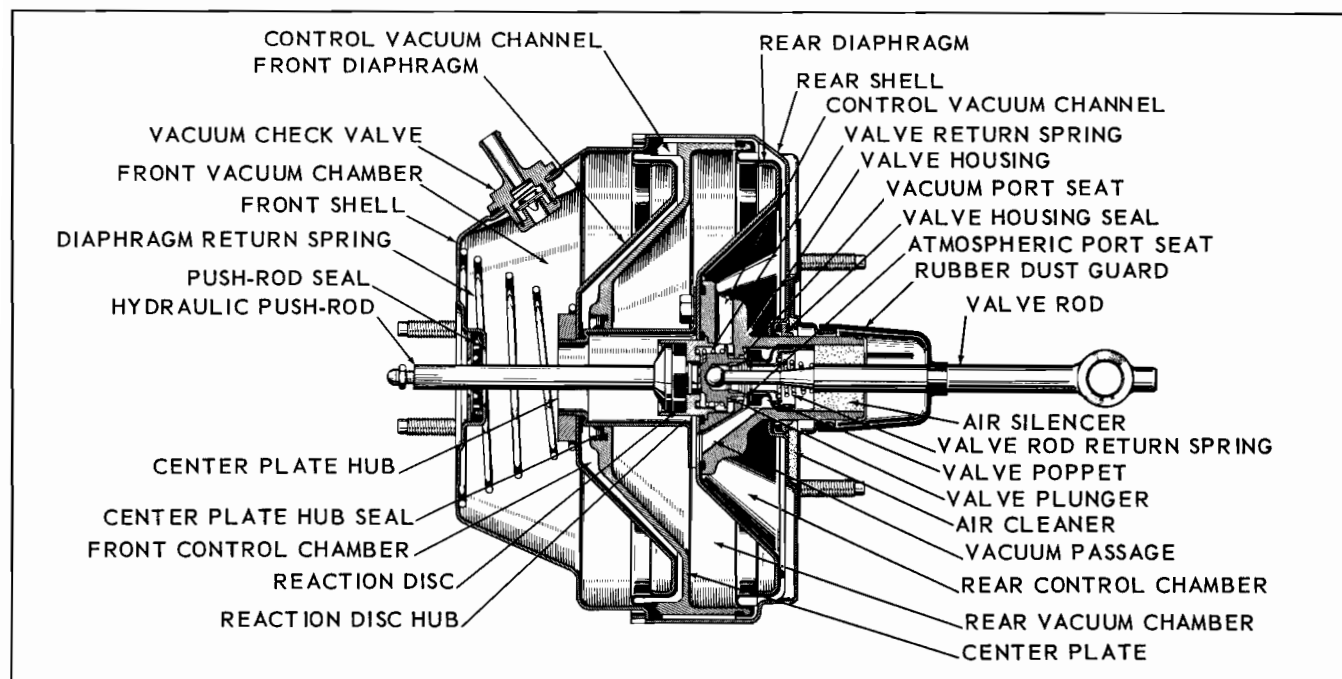


Fig. 7 Cutaway View of Tandem Diaphragm Tandem Type Units

OPERATION

The operation of the tandem diaphragm type Master-Vac is basically the same as for the single diaphragm type, as covered on pages 3 and 4, except for the vacuum passages in the center plate hub and in the valve housing leading to the control valve and the vacuum or air channels from the control valve to the chamber at the right of the rear diaphragm and to the right of the front diaphragm. In the release position, vacuum is present on both sides of the front and rear diaphragms. Upon application, atmospheric pressure is admitted through the air cleaner, air strainer, and control valve to the chamber at the right of the rear diaphragm and through the passages at the outer rim of the center plate to the chamber to the right of the front diaphragm. Other than the double diaphragms, and the vacuum and air passages, the operation is the same as for the single diaphragm type Master-Vac.

BENCH OVERHAUL

Due to the differences in construction of the Tandem Diaphragm type Master-Vac, the bench overhaul procedure differs considerably from the procedure for the single diaphragm type Master-Vac. The following procedure applies only to the tandem diaphragm type — Master-Vac complete with master cylinder.

DISASSEMBLY

Always use a Bendix Repair Kit when overhauling a Master-Vac. For identification of Master-Vac refer to identification code stamped on flat of rear shell. For correct Repair Kit to use and complete list of service parts, refer to Bendix Power Brake Parts Catalog.

DISASSEMBLY

The following service procedure applies to the complete Master-Vac (vacuum power section plus master cylinder.)

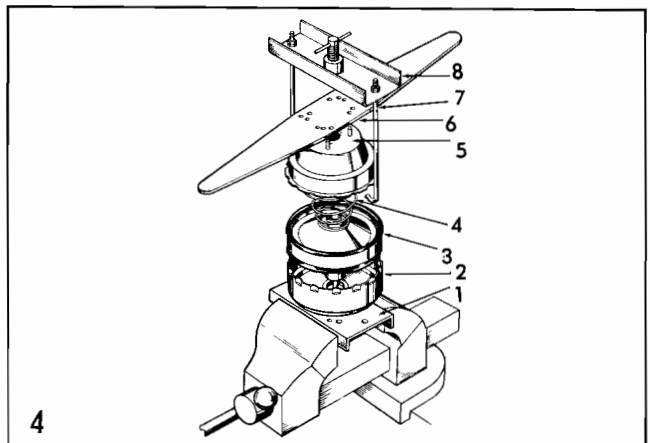
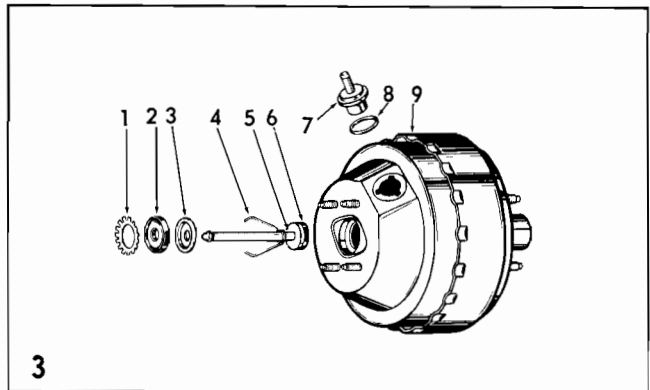
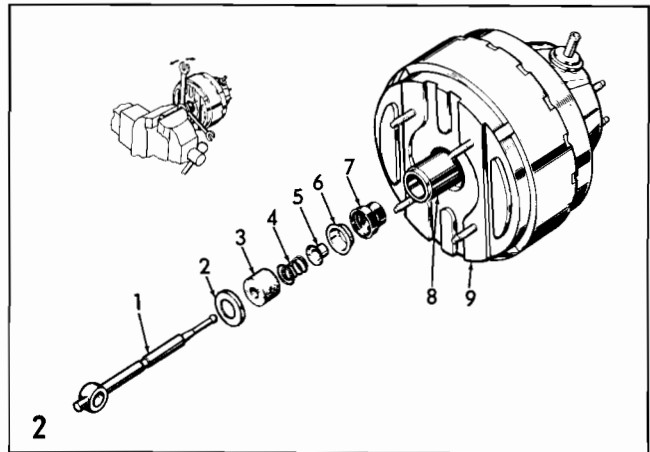
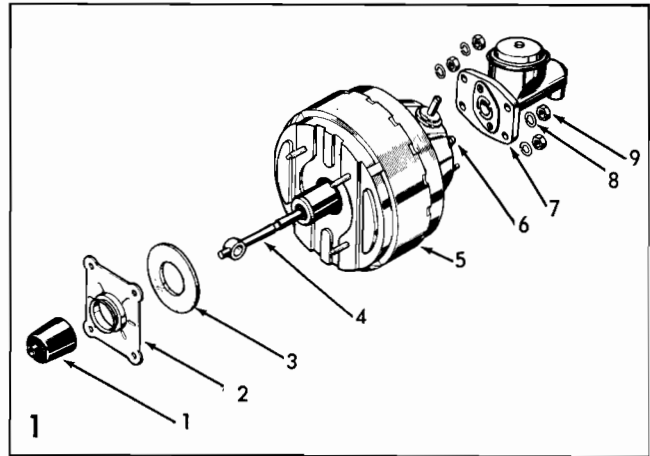
1. Scribe across master cylinder flange, front and rear shells. Remove four master hydraulic cylinder attaching nuts (9) and lockwashers (8) and lift off master cylinder assembly (7). Remove rubber guard (1) from valve rod (4), then remove retainer plate (2) and air filter (3) from rear shell.

2. Remove strainer (3) from valve hub with ice pick. With valve rod in vertical position, squirt alcohol down valve rod to wet rubber grommet in valve plunger at ball end of valve rod. Clamp valve rod in vise, see inset upper left. Leave just enough space between steel retainer on plastic valve sleeve and side of vise jaw for two medium sized open end wrenches. Use wrench nearest to vise as a pry to force valve plunger off ball end of valve rod. **WARNING:** Hold power unit (9) when separating valve rod from valve plunger to prevent power unit from falling which might damage plastic parts. Remove valve rod (1) from vise. Pry retainer (2) off end of valve housing (8), being careful not to chip plastic housing and then remove poppet spring (4), spring retainer (5), poppet retainer (6) and poppet (7).

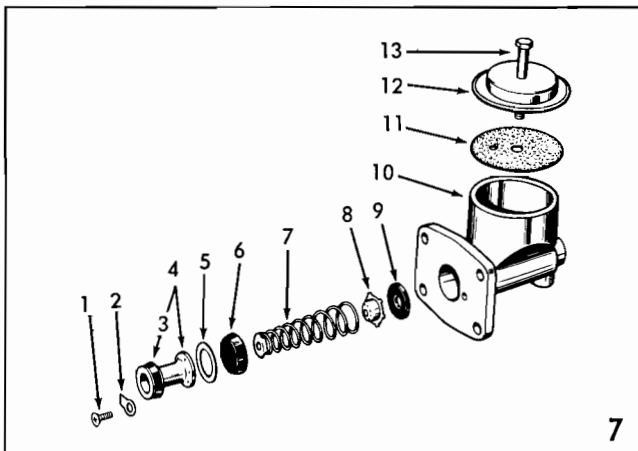
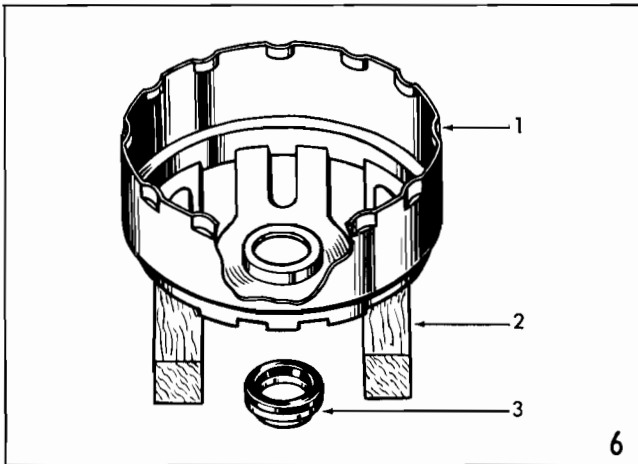
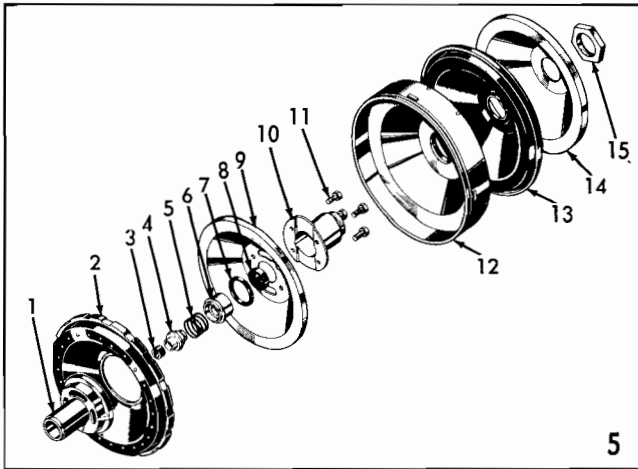
3. Remove seal retainer (1) from front shell by prying one tooth of retainer away from the shell at a time progressing around the retainer, then remove seal (2) with washer (3). Release ends of spring retainer (4) from center plate hub with long nose pliers and remove hydraulic push-rod (5) with spring from unit.

NOTE: DO NOT remove valve (7) from front shell unless check valve is defective. To remove check valve from front shell, press in against check valve and turn check valve counter-clockwise just enough to align retaining lugs on check valve with cut-outs in the shell, then remove check valve and "O" Ring Seal (8).

4. Clamp fixture base (1) in vise, insert studs and housing sleeve thru holes in base. Place bar wrench (6) over studs on front shell (5) and then attach hold down plate (8) to fixture base with hook bolts (7). Tighten center bolt just enough to free lock at outer rim of front shell. Turn bar wrench counter-clockwise just enough to bring cut-outs on front shell in line with lances on rear shell. Loosen center bolt, tap front shell with soft hammer to break bond between shells and diaphragm. It may be necessary to pry against front shell to permit shells to begin separating. When shells begin separating, press down firmly against front shell to offset compression on diaphragm return spring (4) while removing hold down plate, bar wrench, front shell, and return spring. Remove diaphragms and center plate assembly (3) from rear shell (2). Remove rear shell from fixture base.



DISASSEMBLY



5. Clamp hex nut (15) in vise and turn center plate and diaphragm assembly counter-clockwise by hand to loosen nut. Remove nut (15), front diaphragm plate (14), front diaphragm (13) and center plate (12). With 7/16" wrench, remove four cap screws and lock washers (11). Press down on hub while releasing last screw to offset valve return spring load. Lift off center plate hub (10) and rear diaphragm plate (9). Remove reaction disc housing (6) and vacuum seal (7). Remove valve poppet (4), valve return spring (5), valve grommet (3). Press out reaction disc (8) from reaction disc housing (1). Remove rear diaphragm (2) from valve housing (1).

6. NOTE: DO NOT remove bearing seal from rear shell unless seal is defective or new seal is available. To remove bearing seal (3) from rear shell and studs assembly (1), place shell on blocks (2) in position shown. Insert bit of screw driver against lip of seal and drive seal out of rear shell.

7. Hold in against piston (4) while removing screws (1) and plate washer (2), then remove piston assembly (4), washer (5), cup (6), spring (7), residual check valve (8) and seal (9). If secondary cup (3) is damaged, remove cup from piston with ice pick or thin blade screw driver. Remove cover screw (13), cover (12) and gasket (11) from master cylinder housing (10).

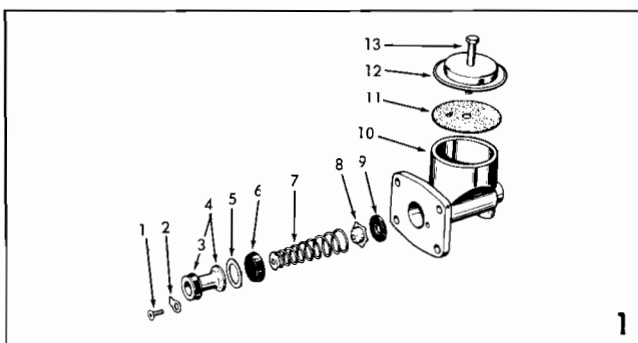
CLEANING

After disassembly, immersion of all metal parts in Bendix Metalclene or Speedclene is recommended. Plastic parts, such as: center plate and valve housing as well as rubber parts, should be cleaned only in alcohol. Care should be taken to prevent chipping or damaging plastic parts in handling. After parts have been thoroughly cleaned, those parts which come in contact with hydraulic brake fluid, should be rewashed in clean alcohol before assembly. Use air hose to blow out dirt and cleaning solvent from recesses and internal passages. When overhauling a Master-Vac, use all parts furnished in the Master-Vac Repair Kit. DISCARD ALL OLD RUBBER PARTS EXCEPT CENTER PLATE SEAL WHICH IS NOT REPLACEABLE.

INSPECTION

Inspect all other parts for damage or excessive wear. Replace any damaged, worn, or chipped parts. Inspect hydraulic cylinder bore for signs of scoring, rust, pitting or etching. Any of these will require replacement of hydraulic cylinder. If center plate hub is corroded or shows signs of rusting, polish with fine steel wool. If pitted, replace. If center plate seal is defective, or center plate is damaged, replace center plate and seal assembly.

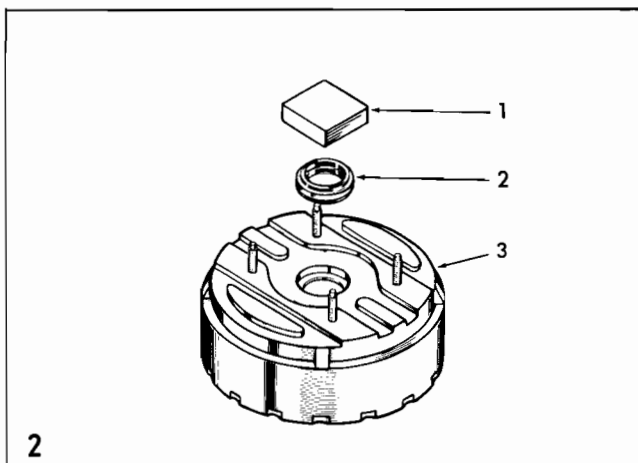
ASSEMBLY



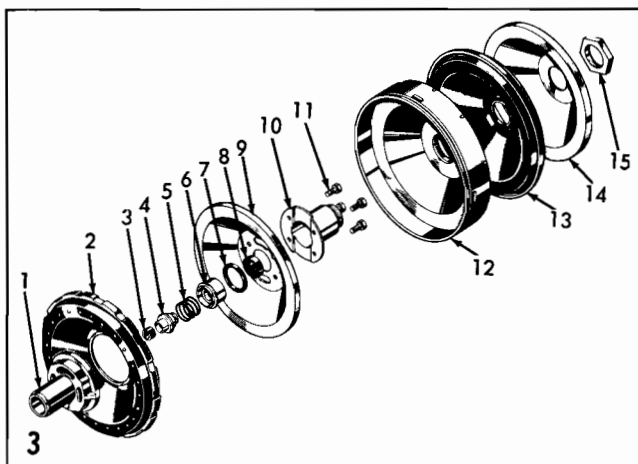
1. Clamp master cylinder housing (10) in vise. Dip hydraulic cylinder parts in brake fluid and assemble check valve seal (9), residual check valve (8) and piston return spring (7) in bore of cylinder in order shown. If secondary piston cup (3) was removed from piston dip cup in brake fluid and assemble cup in groove of piston with lip of cup as shown. Place washer (5) and primary cup (6) on end of piston (4) and guide into cylinder bore. Press in against piston to compress spring while attaching plate washer (2) to cylinder with screw (1). Securely tighten screw. Install new gasket (11) in cover (12) and attach cover with center bolt (13).

ASSEMBLY

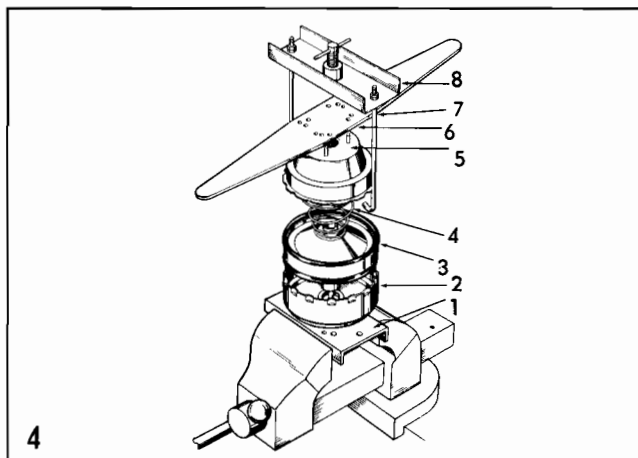
2. Place rear shell on block to back up plate around center hole and press new rear shell seal (2) into rear shell (1) with seal tool (3) part no. 73799. Lip side of seal to be assembled next to recess in shell. Top outside flange of seal to be flush with shell surface adjacent to seal.



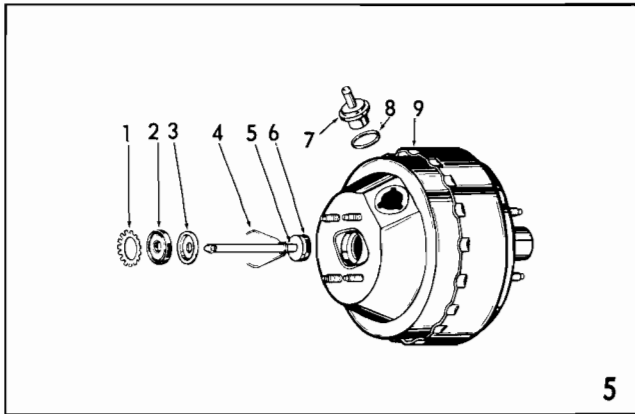
3. Place rear diaphragm (2) on valve housing (1). Assemble new rubber grommet (3) in valve plunger (4) with 45° short I.D. chamfer out. Do not use any type of lubricant on rubber grommet during assembly. Apply Bendix type "O" lubricant lightly to front and rear outside bearing areas of valve plunger being careful not to get any lubricant on rubber grommet. Insert grommet end of valve plunger in recess of valve housing and assemble valve return spring (5). Place vacuum seal (7) over reaction disc hub (6) and assemble reaction disc hub, rear diaphragm (2), diaphragm plate (9) and center plate hub (10) on valve housing (1). Align holes in center plate hub and holes in diaphragm plate with holes in valve housing. Compress valve spring and assemble four attaching screw and lockwasher assemblies (11). Tighten screws to a torque of 40 to 60 inch pounds. Lightly apply Bendix type "O" lubricant to O.D. of valve body sleeve and to O.D. of center plate sleeve. Apply Bendix type "O" lubricant liberally to seal in center plate and carefully guide center plate and seal (12) over center plate sleeve. Assemble front diaphragm (13), front diaphragm plate (14) and nut (15) on center plate hub. Leave nut loose and align three guide lugs at outer rim of center plate with three of the lugs on rear diaphragm. Clamp nut in vise and turn diaphragms and center plate as an assembly by hand to securely tighten nut. Torque to 120 to 180 inch pounds.



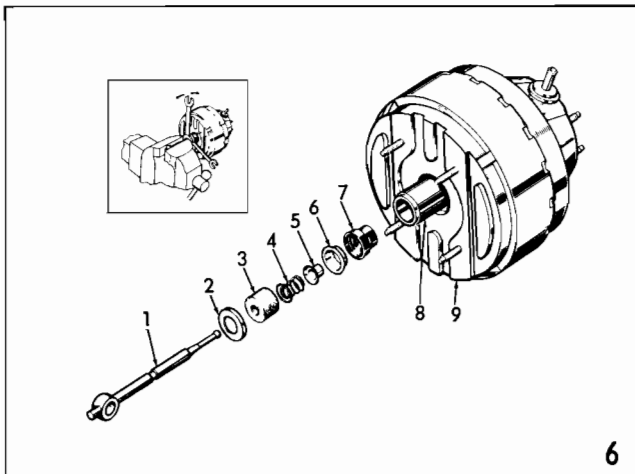
4. Apply talcum powder to inside wall of rear diaphragm shell. Apply Bendix type "O" lubricant liberally to bearing seal in rear shell. Apply DC-4 lubricant liberally to scalloped bearing surface of front shell. Clamp holding fixture base (1) in vise and insert studs in rear shell through matching holes of fixture. When assembling the center plate and diaphragm assembly (3) in the rear shell (2), the rear diaphragm and center plate lugs must be aligned between the lances on the rear shell. Carefully guide valve housing sleeve through bearing seal in rear shell keeping center plate and diaphragms in correct alignment. Work outer rim of front diaphragm into rear shell so that outer rim of front diaphragm is under each of the retaining lances on the rear shell. Place small diameter end of diaphragm return spring (4) over nut on center plate hub and position front shell (5) on spring so that scribe marks on front and rear shells will be aligned when shells are locked in place. Place bar wrench (6) over studs of front shell and then attach holddown plate (8) with hook bolts (7). Before tightening center bolt, make certain cut-outs on front shell are aligned with retaining lances on rear shell. Guide rim of diaphragm into rear shell. Tighten center bolt sufficient to compress rim of front diaphragm sufficient to clear lock on front shell. Then twist front shell (5) clockwise in relation to rear shell until stop is contacted. Remove holddown plate and bar wrench and remove power unit from holding fixture.



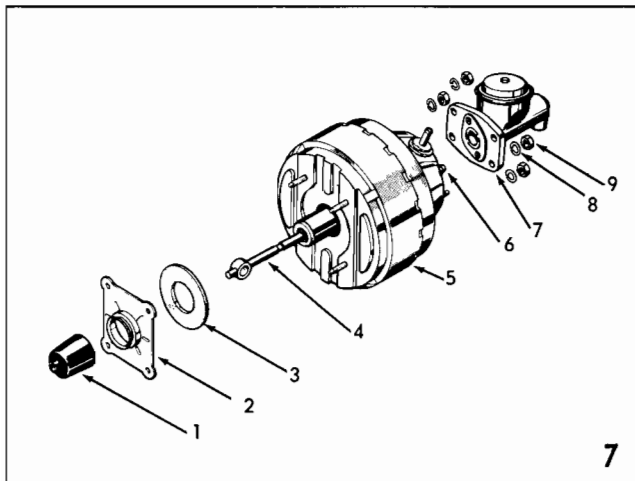
ASSEMBLY



5



6



7

5. Apply Bendix type "O" lubricant liberally to entire surface of reaction disc (6) and to piston end of hydraulic push-rod (5). Place reaction disc on piston end of push-rod with stepped side of reaction disc away from push-rod. Apply Bendix type "O" lubricant sparingly to push-rod keeping lubricant away from adjusting screw end of push-rod. **CAUTION:** Under no condition should lubricant be allowed to get on adjustment screw threads. Insert push-rod with reaction disc on end of push-rod into reaction disc hub. Assemble retainer spring (4) over end of push-rod and press ends down to lock in position below threaded end of center plate hub. Twist push-rod to make certain reaction disc is seated in reaction disc hub and there are no air pockets between the reaction disc and end of push-rod. Assemble seal support plate (3) in recess of seal (2) with concave side up. Then assemble seal with support plate in recess of front shell (9). Press seal retainer (1) into shell recess until retainer is locked in recess of shell. If vacuum check valve (7) was removed from front shell, install new "O" ring gasket (8) with check valve in front shell. Push and turn check valve **clockwise** to lock check valve in front shell.

6. Wet poppet valve (7) in alcohol and assemble poppet in valve housing, smaller diameter and of poppet first; wet poppet retainer (6) in alcohol and assemble with flange out. Press in against retainer to make certain shoulder on retainer is positioned inside of poppet. Assemble spring retainer (5), flange side out, press in until seated against poppet retainer. Assemble retainer (2), air strainer (3) and poppet return spring (4) over ball end of valve rod (1) as shown. Wet rubber grommet in valve plunger and ball end of valve rod in alcohol. Guide spring and strainer into valve housing and assemble ball end of valve rod in valve plunger. Tap end of valve rod with soft hammer to lock ball end of rod in valve plunger. Press strainer into position in housing and assemble retainer (2) on end of valve housing being careful not to chip plastic housing.

7. Assemble air filter (3) in recess of rear shell of power section (5), align and assemble boot and filter retainer plate (2) over four mounting studs. Dip small diameter end of rubber guard (1) in alcohol and assemble guard over eye end of valve rod. Slide small diameter end of guard into recessed area of valve rod and assemble outer lip of guard over flange of retainer plate.

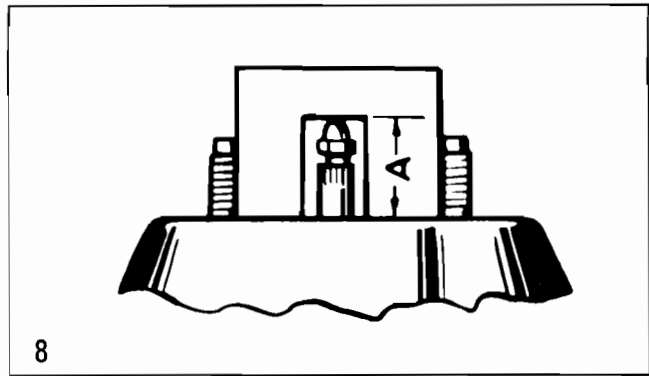
NOTE: Before proceeding, check the distance "A" from the end of the push-rod (6) to the hydraulic cylinder mounting face at the front end of the power unit. This dimension "A," see Fig. 8 should be 1.250"-1.245" for unit "CH-1," and .920-.915 for unit "PL." If push-rod length is not correct, follow push-rod adjustment procedure below. When push-rod length is correct, attach master cylinder (7) to power section with lockwashers (8) and nuts (9). Securely tighten nuts.

ASSEMBLY

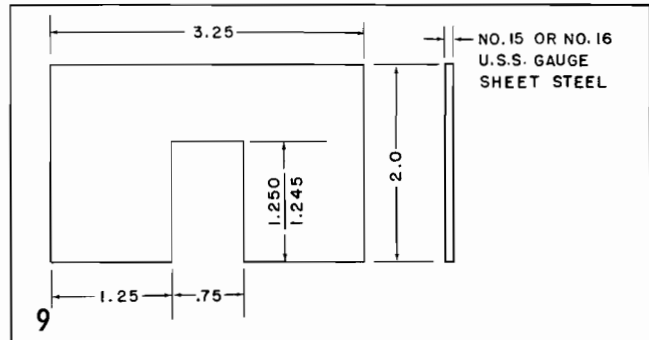
PUSH-ROD ADJUSTMENT

The self-locking adjustment screw is set to the correct dimension at the time of original assembly of the power unit. **Under normal service no further adjustment should be needed providing the push-rod assembly remains in the original Master-Vac.** If, however, the push-rod is transferred to another Master-Vac or a new push-rod is used, adjustment will be necessary. To adjust push-rod, hold serrated end of push-rod with cross milled pliers and turn adjusting screw "IN" to shorten, "OUT" to lengthen push-rod using either a height gauge or a micrometer gauge, see Fig. 40 and 41 for details for making either or both height gauges.

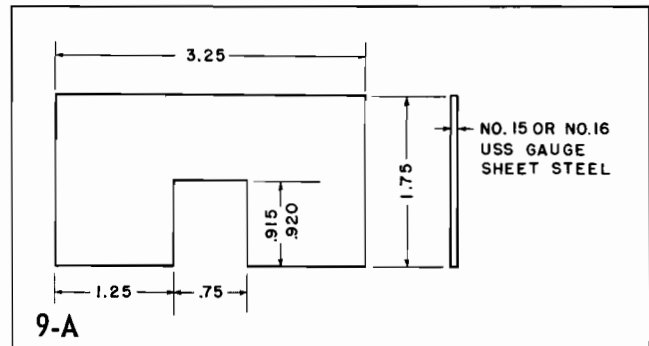
ASSEMBLY IS NOW COMPLETED



Gauging Push Rod Length



Details for Making Push-Rod Gauge



Details for Making Push-Rod Gauge

TROUBLE SHOOTING

Brake troubles may be easily diagnosed if the complaint is understood. The trouble will always appear in one or more of the four common complaints covered below. Related parts of the basic wheel brake system should be checked and corrections made in adjustments, lubrication and lining specifications, or other components in accordance with the vehicle manufacturer's recommendations.

The following briefly covers the conditions that apply to the Master-Vac and corrections should be made in accordance with procedures covered in this manual.

1 HARD PEDAL

BASIC BRAKES: The pedal mechanism should be thoroughly checked for free movement of all parts and lubricated per vehicle manufacturer's specification. Glazed linings or linings saturated with fluid should be replaced.

MASTER-VAC: Check for vacuum leaks in system, collapsed or restricted vacuum hose or line, and also for low manifold vacuum. Possible restricted air cleaner or internal vacuum leak.

2 "GRABBY" BRAKES

BASIC BRAKES: Can be caused by grease or brake fluid on lining, brake shoe anchor pins positioned incorrectly or scored drums.

MASTER-VAC: Possibly in control valve portion of diaphragm or at reaction rod.

3 PEDAL GOES TO THE FLOOR

BASIC BRAKES: Require adjustment or replacement of shoes and lining. Check for cracked drum and leaks in hydraulic system.

MASTER-VAC: Reservoir fluid level low—air in hydraulic system of Master-Vac, in brake lines, or in brake wheel cylinders. Internal hydraulic leak at primary piston cup.

4 BRAKES FAIL TO RELEASE

BASIC BRAKES: Pedal mechanism not operating freely — brakes improperly adjusted — anchor pins bound up.

MASTER-VAC: Possibly at fluid compensating port, in the valve portion of the piston, excessive friction or bind in pivot points of Master-Vac bracket levers or incorrect push-rod adjustment.



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